

**§ 25.703 Takeoff warning system.**

A takeoff warning system must be installed and must meet the following requirements:

(a) The system must provide to the pilots an aural warning that is automatically activated during the initial portion of the takeoff roll if the airplane is in a configuration, including any of the following, that would not allow a safe takeoff:

(1) The wing flaps or leading edge devices are not within the approved range of takeoff positions.

(2) Wing spoilers (except lateral control spoilers meeting the requirements of § 25.671), speed brakes, or longitudinal trim devices are in a position that would not allow a safe takeoff.

(b) The warning required by paragraph (a) of this section must continue until—

(1) The configuration is changed to allow a safe takeoff;

(2) Action is taken by the pilot to terminate the takeoff roll;

(3) The airplane is rotated for takeoff; or

(4) The warning is manually deactivated by the pilot.

(c) The means used to activate the system must function properly throughout the ranges of takeoff weights, altitudes, and temperatures for which certification is requested.

[Amdt. 25-42, 43 FR 2323, Jan. 16, 1978]

## LANDING GEAR

**§ 25.721 General.**

(a) The main landing gear system must be designed so that if it fails due to overloads during takeoff and landing (assuming the overloads to act in the upward and aft directions), the failure mode is not likely to cause—

(1) For airplanes that have passenger seating configuration, excluding pilots seats, of nine seats or less, the spillage of enough fuel from any fuel system in the fuselage to constitute a fire hazard; and

(2) For airplanes that have a passenger seating configuration, excluding pilots seats, of 10 seats or more, the spillage of enough fuel from any part of the fuel system to constitute a fire hazard.

(b) Each airplane that has a passenger seating configuration excluding pilots seats, of 10 seats or more must be designed so that with the airplane under control it can be landed on a paved runway with any one or more landing gear legs not extended without sustaining a structural component failure that is likely to cause the spillage of enough fuel to constitute a fire hazard.

(c) Compliance with the provisions of this section may be shown by analysis or tests, or both.

[Amdt. 25-32, 37 FR 3969, Feb. 24, 1972]

**§ 25.723 Shock absorption tests.**

(a) It must be shown that the limit load factors selected for design in accordance with § 25.473 for takeoff and landing weights, respectively, will not be exceeded. This must be shown by energy absorption tests except that analyses based on earlier tests conducted on the same basic landing gear system which has similar energy absorption characteristics may be used for increases in previously approved takeoff and landing weights.

(b) The landing gear may not fail in a test, demonstrating its reserve energy absorption capacity, simulating a descent velocity of 12 f.p.s. at design landing weight, assuming airplane lift not greater than the airplane weight acting during the landing impact.

[Amdt. 25-23, 35 FR 5675, Apr. 8, 1970, as amended by Amdt. 25-46, 43 FR 50595, Oct. 30, 1978; Amdt. 25-72, 55 FR 29777, July 20, 1990]

**§ 25.725 Limit drop tests.**

(a) If compliance with § 25.723(a) is shown by free drop tests, these tests must be made on the complete airplane, or on units consisting of a wheel, tire, and shock absorber, in their proper positions, from free drop heights not less than—

(1) 18.7 inches for the design landing weight conditions; and

(2) 6.7 inches for the design takeoff weight conditions.

(b) If airplane lift is simulated by air cylinders or by other mechanical means, the weight used for the drop must be equal to *W*. If the effect of airplane lift is represented in free drop tests by an equivalent reduced mass,

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the landing gear must be dropped with an effective mass equal to

$$W_e = W \times \frac{h + (1 - L)d}{h + d}$$

where—

$W_e$  = the effective weight to be used in the drop test (lbs.);

$h$  = specified free drop height (inches);

$d$  = deflection under impact of the tire (at the approved inflation pressure) plus the vertical component of the axle travel relative to the drop mass (inches);

$W = W_M$  for main gear units (lbs.), equal to the static weight on that unit with the airplane in the level attitude (with the nose wheel clear in the case of nose wheel type airplanes);

$W = W_T$  for tail gear units (lbs.), equal to the static weight on the tail unit with the airplane in the tail-down attitude;

$W = W_N$  for nose wheel units (lbs.), equal to the vertical component of the static reaction that would exist at the nose wheel, assuming that the mass of the airplane acts at the center of gravity and exerts a force of 1.0  $g$  downward and 0.25  $g$  forward; and

$L$  = ratio of the assumed airplane lift to the airplane weight, but not more than 1.0.

(c) The drop test attitude of the landing gear unit and the application of appropriate drag loads during the test must simulate the airplane landing conditions in a manner consistent with the development of a rational or conservative limit load factor value.

(d) The value of  $d$  used in the computation of  $W_e$  in paragraph (b) of this section may not exceed the value actually obtained in the drop test.

(e) The limit inertia load factor  $n$  must be determined from the free drop test in paragraph (b) of this section according to the following formula:

$$n = n_j \times \frac{W_e}{W} + L$$

where—

$n_j$  = the load factor developed in the drop test (that is, the acceleration  $dv/dt$  in  $g$ 's recorded in the drop test) plus 1.0; and

$W_e$ ,  $W$ , and  $L$  are the same as in the drop test computation.

(f) The value of  $n$  determined in paragraph (e) of this section may not be more than the limit inertia load factor

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used in the landing conditions in § 25.473.

[Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25–23, 35 FR 5675, Apr. 8, 1970]

### § 25.727 Reserve energy absorption drop tests.

(a) If compliance with the reserve energy absorption condition specified in § 25.723(b) is shown by free drop tests, the drop height may not be less than 27 inches.

(b) If airplane lift is simulated by air cylinders or by other mechanical means, the weight used for the drop must be equal to  $W$ . If the effect of airplane lift is represented in free drop tests by an equivalent reduced mass, the landing gear must be dropped with an effective mass,

$$W_e = \frac{Wh}{h + d}$$

where the symbols and other details are the same as in § 25.725(b).

[Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25–23, 35 FR 5675, Apr. 8, 1970]

### § 25.729 Retracting mechanism.

(a) *General.* For airplanes with retractable landing gear, the following apply:

(1) The landing gear retracting mechanism, wheel well doors, and supporting structure, must be designed for—

(i) The loads occurring in the flight conditions when the gear is in the retracted position,

(ii) The combination of friction loads, inertia loads, brake torque loads, air loads, and gyroscopic loads resulting from the wheels rotating at a peripheral speed equal to 1.3  $V_s$  (with the flaps in takeoff position at design takeoff weight), occurring during retraction and extension at any airspeed up to 1.6  $V_{s1}$  (with the flaps in the approach position at design landing weight), and

(iii) Any load factor up to those specified in § 25.345(a) for the flaps extended condition.

(2) Unless there are other means to decelerate the airplane in flight at this speed, the landing gear, the retracting mechanism, and the airplane structure (including wheel well doors) must be